

IN THE CLAIMS

Claim 1. (previously amended)

A subarray beamformer for a multi-beam phased array antenna comprising: a plurality of phased array antenna beamforming layers comprising; a first beamforming layer having a first plurality of combiners in a first orientation and combining a first set of signals to form a second set of signals; and a second beamforming layer having a second plurality of combiners in a second orientation coupled to and opposing said first plurality of combiners, said second plurality of combiners combining said second set of signals to form at least one first combined signal,

wherein said first plurality of combiners are in a first unidirectional orientation and said second plurality of combiners are in a second unidirectional orientation orthogonal to said first unidirectional orientation.

Claim 2. (canceled)

Claim 3. (currently amended)

A beamformer as in claim 1 wherein said plurality of phased array antenna beamforming layers further comprise: a third beamforming layer having a third plurality of combiners in a third orientation and combining a third set of signals to form a ~~forth~~ fourth set of signals; and a ~~forth~~ fourth beamforming layer having a ~~forth~~ fourth plurality of combiners in a ~~forth~~ fourth orientation coupled to and opposing said third plurality of combiners, said ~~forth~~ fourth plurality of combiners combining said ~~forth~~ fourth set of signals to form at least one second combined signal.

Claim 4. (currently amended)

A beamformer as in claim 3 wherein said third plurality of combiners are in a third unidirectional orientation and said ~~forth~~ fourth plurality of combiners are in a ~~forth~~ fourth unidirectional orientation orthogonal to said third unidirectional orientation.

Claim 5. (currently amended)

A beamformer as in claim 3 wherein said first beamforming layer and said ~~forth~~ fourth beamforming layer are formed as a single beamforming layer.

Claim 6. (original)

A beamformer as in claim 3 wherein said second beamforming layer and said third beamforming layer are formed as a single beamforming layer.

Claim 7. (currently amended)

A beamformer as in claim 3 wherein said ~~forth~~ fourth beamforming layer comprises fewer combiners than said third beamforming layer.

Claim 8. (original)

A beamformer as in claim 1 wherein said second beamforming layer comprises fewer combiners than said first beamforming layer.

Claim 9. (original)

An assembly as in claim 1 wherein said subarray beamformer comprises fewer beamforming layers than a quantity of radiating elements coupled thereto.

Claim 10. (original)

A beamformer as in claim 1 wherein said plurality of phased array antenna beamforming layers comprise approximately less than or equal to four beamforming layers.

Claim 11. (original)

A beamformer as in claim 1 wherein each combiner within said first plurality of combiners and said second plurality of combiners combine signals received from each tile within a beamforming subarray of tiles.

Claim 12. (canceled)

Claim 13. (canceled)

Claim 14. (canceled)

Claim 15. (currently amended)

A beamformer as in claim [[14]] 42 wherein said third plurality of dividers are in a third unidirectional orientation and said ~~forth~~ fourth plurality of dividers are in a ~~forth~~ fourth unidirectional orientation orthogonal to said third unidirectional orientation.

Claim 16. (Currently Amended)

A beamformer as in claim [[14]] 42 wherein said first beamforming layer and said ~~forth~~ fourth beamforming layer are formed as a single beamforming layer.

Claim 17. (Currently Amended)

A beamformer as in claim [[14]] 42 wherein said second beamforming layer and said third beamforming layer are formed as a single beamforming layer.

Claim 18. (Currently Amended)

A beamformer as in claim [[14]] 42 wherein said ~~forth~~ fourth beamforming layer comprises fewer dividers than said third beamforming layer.

Claim 19. (Currently Amended)

A beamformer as in claim [[12]] 41 wherein said second beamforming layer comprises fewer dividers than said first beamforming layer.

Claim 20. (Currently Amended)

An assembly as in claim [[12]] 41 wherein said subarray beamformer comprises fewer beamforming layers than a quantity of radiating elements coupled thereto.

Claim 21. (Currently Amended)

A beamformer as in claim [[12]] 41 wherein said plurality of phased array antenna beamforming layers comprise approximately less than or equal to four beamforming layers.

Claim 22. (Currently Amended)

A beamformer as in claim [[12]] 41 wherein each divider within said first plurality of dividers and said second plurality of dividers divide signals for each tile within a beamforming subarray of tiles.

Claim 23. (original)

A multi-beam phased array antenna assembly comprising: a plurality of radiating elements receiving a plurality of beams having a first set of signals; a common structure coupled to said plurality of radiating elements; a plurality of signal conditioners coupled to said common structure; and a subarray beamformer coupled to said plurality of signal conditioners and comprising: a plurality of phased array antenna beamforming layers comprising: a first beamforming layer having a first plurality of combiners in a first orientation and combining said first set of signals to form a second set of signals; and a second beamforming layer having a second plurality of combiners in a second orientation coupled to and opposing said first plurality of combiners, said second plurality of combiners combining said second set of signals to form at least one first combined signal.

Claim 24. (original)

An assembly as in claim 23 further comprising a cover coupled to said subarray beamformer.

Claim 25. (currently amended)

An assembly as in claim 23 wherein said plurality of phased array antenna beamforming layers further comprise: a third beamforming layer having a third plurality of combiners in a third orientation and combining a third set of signals to form a ~~forth~~ fourth set of signals; and a ~~forth~~ fourth beamforming layer having a ~~forth~~ fourth plurality

of combiners in a ~~forth~~ fourth orientation coupled to and opposing said third plurality of combiners, said ~~forth~~ fourth plurality of combiners combining said ~~forth~~ fourth set of signals to form at least one second combined signal.

Claim 26. (original)

An assembly as in claim 23 wherein said subarray beamformer comprises fewer beamforming layers than a quantity of radiating elements within said plurality of radiating elements.

Claim 27. (original)

An assembly as in claim 23 wherein said plurality of phased array antenna beamforming layers comprise approximately less than or equal to four beamforming layers.

Claim 28. (original)

An assembly as in claim 23 wherein said plurality of phased array antenna beamforming layers comprise approximately two beamforming layers.

Claim 29. (original)

A multi-beam phased array antenna assembly comprising: a plurality of radiating elements transmitting a plurality of beams having a first set of signals; a common structure coupled to said plurality of radiating elements; a plurality of signal conditioners coupled to said common structure; and a subarray beamformer coupled to said plurality of signal conditioners and comprising; a plurality of phased array antenna beamforming layers comprising; a second beamforming layer having a second plurality of dividers in a second orientation and dividing at least one first combined signal to form a second set of signals; and a first beamforming layer having a first plurality of dividers in a first orientation coupled to and opposing said second plurality of dividers, said first plurality of dividers dividing said second set of signals to form said first set of signals.

Claim 30. (original)

An assembly as in claim 29 further comprising a cover coupled to said subarray beamformer.

Claim 31. (currently amended)

An assembly as in claim 29 wherein said plurality of phased array antenna beamforming layers further comprise: a ~~forth~~ fourth beamforming layer having a ~~forth~~ fourth plurality of dividers in a ~~forth~~ fourth orientation and dividing at least one second combined signal to form a ~~forth~~ fourth set of signals; and a third beamforming layer having a third plurality of dividers in a third orientation coupled to and opposing said ~~forth~~ fourth plurality of dividers, said third plurality of dividers dividing said ~~forth~~ fourth set of signals to form a third set of signals.

Claim 32. (original)

An assembly as in claim 29 wherein said subarray beamformer comprises fewer beamforming layers than a quantity of radiating elements within said plurality of radiating elements.

Claim 33. (original)

An assembly as in claim 29 wherein said plurality of phased array antenna beamforming layers comprise approximately less than or equal to four beamforming layers.

Claim 34. (original)

An assembly as in claim 29 wherein said plurality of phased array antenna beamforming layers comprise approximately two beamforming layers.

Claim 35. (original)

A satellite having a multi-beam phased array antenna assembly comprising; a plurality of radiating elements receiving a plurality of beams having a first set of signals; a common structure coupled to said plurality of radiating elements; a plurality of signal

conditioners coupled to said common structure; and a subarray beamformer coupled to said plurality of signal conditioners and comprising; a plurality of phased array antenna beamforming layers comprising; a first beamforming layer having a first plurality of combiners in a first orientation and combining said first set of signals to form a second set of signals; and a second beamforming layer having a second plurality of combiners in a second orientation coupled to and opposing said first plurality of combiners, said second plurality of combiners combining said second set of signals to form at least one first combined signal.

Claim 36. (original)

A satellite as in claim 35 wherein said subarray beamformer comprises fewer beamforming layers than a quantity of radiating elements within said plurality of radiating elements.

Claim 37. (original)

A satellite having a multi-beam phased array antenna assembly comprising: a plurality of radiating elements transmitting a plurality of beams having a first set of signals; a common structure coupled to said plurality of radiating elements; a plurality of signal conditioners coupled to said common structure; and a subarray beamformer coupled to said plurality of signal conditioners and comprising; a plurality of phased array antenna beamforming layers comprising; a second beamforming layer having a second plurality of dividers in a second orientation and dividing at least one first combined signal to form a second set of signals; and a first beamforming layer having a first plurality of dividers in a first orientation coupled to and opposing said second plurality of dividers, said first plurality of dividers dividing said second set of signals to form said first set of signals.

Claim 38. (original)

A satellite as in claim 37 wherein said subarray beamformer comprises fewer beamforming layers than a quantity of radiating elements within said plurality of

radiating elements.

Claim 39. (original)

A method of forming a multi-beam phased array antenna assembly comprising: manufacturing a common structure configured to couple a plurality of radiating elements to a plurality of signal conditioners; coupling a beamforming board to said plurality of signal conditioners; and encasing said plurality of signal conditioners and said beamforming board in said common structure.

Claim 40. (original)

A method as in claim 39 further comprising coupling a plurality of tile elements between said plurality of radiating elements and said beamforming board and within said common structure.

Claim 41. (new)

A subarray beamformer for a multi-beam phased array antenna comprising: a plurality of phased array antenna beamforming layers comprising; a second beamforming layer having a second plurality of dividers in a second orientation and dividing at least one first combined signal to form a second set of signals; and a first beamforming layer having a first plurality of dividers in a first orientation coupled to and opposing said second plurality of dividers, said first plurality of dividers dividing said second set of signals to form a first set of signals, wherein said first plurality of dividers are in a first unidirectional orientation and said second plurality of dividers are in a second unidirectional orientation orthogonal to said first unidirectional orientation.

Claim 42. (new)

A subarray beamformer for a multi-beam phased array antenna comprising: a plurality of phased array antenna beamforming layers comprising; a second beamforming layer having a second plurality of dividers in a second orientation and dividing at least one first combined signal to form a second set of signals; and a first beamforming layer having a first plurality of dividers in a first orientation coupled to and opposing said

second plurality of dividers, said first plurality of dividers dividing said second set of signals to form a first set of signals, wherein said plurality of phased array antenna beamforming layers further comprise: a fourth beamforming layer having a fourth plurality of dividers in a fourth orientation and dividing at least one second combined signal to form a fourth set of signals; and a third beamforming layer having a third plurality of dividers in a third orientation coupled to and opposing said fourth plurality of dividers, said third plurality of dividers dividing said fourth set of signals to form a third set of signals.

Claim 43. (new)

A subarray beamformer for a multi-beam phased array antenna comprising: a plurality of phased array antenna beamforming layers comprising; a second beamforming layer having a second plurality of dividers in a second orientation and dividing at least one first combined signal to form a second set of signals; and a first beamforming layer having a first plurality of dividers in a first orientation coupled to and opposing said second plurality of dividers, said first plurality of dividers dividing said second set of signals to form a first set of signals, wherein said first plurality of dividers are in a first unidirectional orientation and said second plurality of dividers are in a second unidirectional orientation orthogonal to said first unidirectional orientation, and wherein said plurality of phased array antenna beamforming layers further comprise: a fourth beamforming layer having a fourth plurality of dividers in a fourth orientation and dividing at least one second combined signal to form a fourth set of signals; and a third beamforming layer having a third plurality of dividers in a third orientation coupled to and opposing said fourth plurality of dividers, said third plurality of dividers dividing said fourth set of signals to form a third set of signals.